What is Claimed is:

1. A method of operating a control loop for a control valve having a throttling element coupled to a pneumatically operated actuator defining at least a first control chamber, the control loop including a pneumatic amplifier having an inlet port in fluid communication with a supply of control fluid, a first outlet port in fluid communication with the first control chamber of the actuator, and a control fluid valve assembly responsive to a control pressure signal for controlling flow of control fluid between the inlet port and the first outlet port; and an I/P converter adapted to receive an I/P drive signal and generate the control pressure signal, the method comprising:

storing a reference outlet pressure signal;

generating the I/P drive signal based on the reference outlet pressure signal;

receiving a measurement of a pressure level of control fluid from at least the pneumatic amplifier first outlet port;

comparing the measured pressure level to the reference outlet pressure signal to generate an error signal; and

modifying the I/P drive signal based on the error signal.

2. The method of claim 1, in which the reference outlet pressure signal is generated in response to engagement of the throttling element with a travel stop.

3. The method of claim 2, in which the travel stop comprises a valve seat.

4. The method of claim 2, in which the travel stop comprises an upper travel stop.

5. The method of claim 1, in which the reference outlet pressure signal is near 100%.

6. The method of claim 1, in which the reference outlet pressure signal is near 0%.

7. The method of claim 1, in which the control valve further includes a travel sensor adapted to detect detecting a position of the throttling element, and in which the reference outlet pressure signal is generated in response to a failure of the travel sensor.

8. The method of claim 1, further comprising performing a diagnostics routine based on at least one control parameter of the control loop.

9. The method of claim 8, in which the diagnostics routine includes:

receiving a measurement of an inlet port pressure value corresponding to control fluid pressure at the inlet port;

receiving a measurement of a first outlet port pressure value corresponding to control fluid pressure at the first outlet port;

receiving a measurement of a control fluid valve assembly travel value corresponding to a position of the control fluid valve assembly;

calculating a first outlet port area of restriction based on the control fluid valve assembly travel value; and

calculating a first outlet port mass flow rate based on the inlet pressure value, first outlet port pressure value, and first outlet port area of restriction.

10. The method of claim 9, in which the diagnostics routine further includes:

generating a first mass flow profile; and

applying a logic sub-routine to determine a fault condition based on a comparison of the calculated first outlet port mass flow rate and the first mass flow profile.

11. The method of claim 8, in which the diagnostics routine includes:

defining a normal range for the at least one control parameter of the control loop;

triggering a fault signal for operation of the control parameter outside of the normal range;

characterizing operating parameters of the control loop during the fault signal to derive a fault template;

comparing the fault template to sets of stored operating parameters associated with specific component failures; and

identifying at least one specific component failure having a set of stored operating parameters that matches the fault template.

12. The method of claim 8, in which the actuator further defines a second control chamber and the pneumatic amplifier includes a second outlet port in fluid communication with the actuator second control chamber, wherein the control fluid valve assembly further controls flow of fluid from the inlet port to the second outlet port, the method further comprising:

receiving a measurement of a second outlet port pressure level of control fluid at the pneumatic amplifier second outlet port;

comparing the second outlet port pressure level to the first outlet port pressure level to determine a pressure differential value; and

comparing the pressure differential value to the reference outlet pressure signal to generate the error signal.

13. The method of claim 12, in which the diagnostics routine includes:

receiving a measurement of an inlet port pressure value corresponding to control fluid pressure at the inlet port;

receiving a measurement of a first outlet port pressure value corresponding to control fluid pressure at the first outlet port;

receiving a measurement of a second outlet port pressure value corresponding to control fluid pressure at the first outlet port;

receiving a measurement of a control fluid valve assembly travel value

corresponding to a position of the control fluid valve assembly;

calculating a first outlet port area of restriction and a second outlet port area of restriction based on the control fluid valve assembly travel value;

calculating a first outlet port mass flow rate based on the inlet pressure value, first outlet port pressure value, and first outlet port area of restriction; and

calculating a second outlet port mass flow rate based on the inlet pressure value, second outlet port pressure value, and second outlet port area of restriction.

14. The method of claim 13, in which the diagnostics routine further includes:

receiving at least a first mass flow profile; and

applying a logic sub-routine to determine a fault condition based on a comparison of the at least one of the calculated first and second outlet port mass flow rates with the first mass flow profile.

15. The method of claim 1, in which the actuator further defines a second control chamber and the pneumatic amplifier includes a second outlet port in fluid communication with the actuator second control chamber, wherein the control fluid valve assembly further controls flow of fluid from the inlet port to the second outlet port, the method further comprising:

receiving a measurement of a second outlet port pressure level of control fluid at the pneumatic amplifier second outlet port;

comparing the second outlet port pressure level to the first outlet port pressure level to determine a pressure differential value;

comparing the pressure differential value to the reference outlet pressure signal to generate a pressure differential error signal; and

modifying the I/P drive signal based on the pressure differential error signal.

16. The method of claim 1, in which the pneumatic amplifier comprises a spool valve.

17. The method of claim 1, in which the pneumatic amplifier comprises a pneumatic relay.

18. A method of selectively operating a control loop for a control valve in either a travel control mode or a pressure control mode, wherein the control valve has a throttling element coupled to a pneumatically operated actuator defining at least a first control chamber, and in which the control loop includes a pneumatic amplifier having an inlet port in fluid communication with a supply of control fluid, a first outlet port in fluid communication with the actuator first control chamber, and a control fluid valve assembly responsive to a control pressure signal for controlling flow of control fluid between the inlet port and the first outlet port; and an I/P converter adapted to receive an I/P drive signal and generate the control pressure signal; the method comprising:

operating the control loop in travel control mode by:

storing a reference travel signal;

generating the I/P drive signal based on the reference travel signal;

receiving a measurement of a throttling element travel value corresponding to a position of the throttling element;

comparing the measured throttling element travel value to the reference travel signal to generate a travel error signal; and

modifying the I/P drive signal based on the travel error signal; and

operating the control loop in pressure control mode by:

storing a reference outlet pressure signal;

generating the I/P drive signal based on the reference outlet pressure signal;

receiving a measurement of a first outlet port pressure level of control fluid at the pneumatic amplifier first outlet port;

comparing the measured first outlet port pressure level to the reference outlet pressure signal to generate a outlet pressure error signal; and

modifying the I/P drive signal based on the outlet pressure error signal.

19. The method of claim 18, in which the control loop is normally operated in the travel control mode.

20. The method of claim 19, in which the control loop is switched to the pressure control mode in response to engagement of the throttling element with a travel stop.

21. The method of claim 20, in which the travel stop comprises a valve seat.

22. The method of claim 20, in which the travel stop comprises an upper travel stop.

23. The method of claim 19, in which the control loop is switched to the pressure control mode in response to the reference outlet pressure signal nearing 100%.

24. The method of claim 19, in which the control loop is switched to the pressure control mode in response to the reference outlet pressure signal nearing 0%.

25. The method of claim 19, in which the control loop is switched to the pressure control mode when the throttling element travel value fails.

26. The method of claim 18, further comprising performing a diagnostics routine based on at least one control parameter of the control loop.

27. A positioner system adapted to control a pneumatic actuator coupled to a throttling element, the actuator having at least a first control chamber, the positioner system comprising:

a processor and a memory, the processor adapted to receive an outlet pressure set point and generate an I/P drive signal;

an I/P converter operatively coupled to the processor and adapted to generate a pneumatic control signal in response to the I/P drive signal;

a pneumatic amplifier operatively coupled to the I/P converter, the pneumatic amplifier having an inlet port in fluid communication with a supply of control fluid, a first outlet port in fluid communication with the actuator first control chamber, and a control fluid valve assembly adapted to control flow of control fluid from the inlet port to the first outlet port in response to the pneumatic control signal; and

a first outlet port pressure sensor adapted to detect a pressure level at the first outlet port and generate a first outlet port pressure signal, wherein the first outlet port pressure sensor is communicatively coupled to the processor;

wherein the processor is adapted to compare the first outlet port pressure signal to the outlet pressure set point and generate an outlet pressure error signal, and wherein the processor is adapted to modify the I/P drive signal based on the outlet pressure error signal.

28. The system of claim 27, in which the processor includes a routine adapted to perform diagnostics based on at least one control parameter of the positioner system.

29. The system of claim 28, further comprising a displacement sensor adapted to detect a control fluid valve assembly position and an inlet pressure sensor in fluid communication with the inlet port adapted to detect an inlet port pressure, wherein the displacement and inlet pressure sensors are communicatively coupled to the processor.

30. The system of claim 29, in which the diagnostics routine is adapted to generate a first outlet port area of restriction based on the control fluid valve assembly position and calculate a first outlet port mass flow rate of control fluid based on inlet port pressure, first outlet port pressure, and first outlet port area of restriction.

31. The system of claim 28, in which the diagnostics routine is adapted to:

define a normal range for the at least one control parameter;

trigger a fault signal for operation of the control parameter outside of the normal range;

characterize operating parameters of the positioner system during the fault signal to derive a fault template;

compare the fault template to sets of stored operating parameters associated with specific component failures; and

identify at least one specific component failure having a set of stored operating parameters that matches the fault template.

32. The system of claim 27, in which the actuator includes a second control chamber, and in which the pneumatic amplifier further includes a second outlet port in fluid communication with the actuator second control chamber, wherein the control fluid valve assembly also controls flow of control fluid from the inlet port to the second outlet port, the system further comprising a second outlet port pressure sensor adapted to detect a pressure level at the second outlet port and generate a second outlet port pressure signal, wherein the second outlet port pressure sensor is communicatively coupled to the processor.

33. The system of claim 32, in which the processor is adapted to compare the first outlet port pressure signal to the second outlet port pressure signal and generate an outlet pressure differential signal, to compare the outlet pressure differential signal to the outlet pressure set point and generate the outlet pressure differential error signal, and to modify the I/P drive signal based on the outlet pressure differential error signal.

34. A positioner system adapted to control a pneumatic actuator coupled to a throttling element, the actuator having at least a first control chamber, the positioner system comprising:

a processor and a memory, the processor adapted to receive a travel set point and an outlet pressure set point and generate an I/P drive signal based on at least one

of the travel and outlet pressure set points;

an I/P converter operatively coupled to the processor and responsive to the I/P drive signal to generate a pneumatic control signal;

a pneumatic amplifier operatively coupled to the I/P converter, the pneumatic amplifier having an inlet port in fluid communication with a supply of control fluid, a first outlet port in fluid communication with the actuator first control chamber, and a control fluid valve assembly responsive to the pneumatic control signal to control flow of control fluid from the inlet port to the first outlet port;

a first outlet port pressure sensor adapted to detect a pressure level at the first outlet port and generate a first outlet port pressure signal, wherein the first outlet port pressure sensor is communicatively coupled to the processor; and

a throttling element travel sensor adapted to detect a position of the throttling element and generate a throttling element position signal, wherein the throttling element travel sensor is communicatively coupled to the processor;

wherein the processor is adapted to operate in a travel control mode in which the throttling element position signal is compared to the travel set point to generate a travel error signal, wherein the I/P drive signal is modified by the travel error signal, and in a pressure control mode in which the first outlet port pressure signal is compared to the outlet pressure set point to generate an outlet pressure error signal, wherein the I/P drive signal is modified by the outlet pressure error signal.

35. The system of claim 34, in which the processor is normally operated in the travel control mode.

36. The system of claim 35, in which the processor is switched to the pressure control mode in response to engagement of the throttling element with a travel stop.

37. The system of claim 36, in which the travel stop comprises a valve seat.

38. The system of claim 36, in which the travel stop comprises an upper travel stop.

39. The system of claim 35, in which the control loop is switched to the pressure control mode in response to the reference outlet pressure signal nearing 100%.

40. The system of claim 35, in which the control loop is switched to the pressure control mode in response to the reference outlet pressure signal nearing 0%.

41. The system of claim 35, in which the control loop is switched to the pressure control mode when the throttling element position signal fails.

42. The system of claim 34, in which the processor includes a routine adapted to perform diagnostics based on at least one control parameter of the positioner system.

43. A method of detecting faults in a control loop for a control valve having a throttling element coupled to a pneumatically operated actuator, the control loop including a pneumatic amplifier operatively coupled to the actuator and having a control fluid valve assembly responsive to a control pressure signal for controlling flow of control fluid to the actuator, and an I/P converter operatively coupled to the pneumatic amplifier for generating the control pressure signal in response to an I/P drive signal, wherein the I/P drive signal is based on a reference outlet pressure signal, the method comprising:

storing a normal range for a control parameter of the control loop;

triggering a fault signal for operation of the control parameter outside the normal range;

characterizing operating parameters of the control loop during the fault signal to derive a fault template;

comparing the fault template to sets of stored operating parameters associated

with specific component failures; and

identifying at least one specific component failure having a set of stored operating parameters that matches the fault template.

44. The method of claim 43, in which the pneumatic amplifier comprises a spool valve, and in which the control parameter comprises a spool valve position signal.

45. The method of claim 43, in which the pneumatic amplifier comprises a pneumatic relay having a beam, and in which the control parameter comprises a beam position signal.

46. The method of claim 43, in which the control parameter comprises an I/P drive signal.

47. The method of claim 43, in which characterization of the operating parameters includes:

characterizing an I/P drive signal deviation as high or low;

characterizing an outlet pressure error signal as high, nominal or low, wherein the outlet pressure error signal is equal to an outlet pressure reference signal minus a measured outlet pressure signal; and

characterizing a control fluid valve assembly position as largely positive, null, or largely negative.

48. The method of claim 43, in which a fault template comprising a high I/P drive signal deviation, a high outlet pressure error signal, and largely negative control fluid valve assembly position is attributable to one of a group of component faults consisting of a jammed control fluid valve assembly, an I/P O-ring failure, a diaphragm failure, a blocked primary orifice, and a supply pressure near atmospheric pressure.

49. The method of claim 43, in which a fault template comprising a high I/P drive signal deviation, a high outlet pressure error signal, and largely positive control fluid valve assembly position is attributable to one of a group of component faults consisting of an external leak, a pneumatic amplifier diaphragm failure, and a low supply pressure.

50. The method of claim 43, in which a fault template comprising a high I/P drive signal deviation, a nominal outlet pressure error signal, and largely positive control fluid valve assembly position is attributable to one of a group of component faults consisting of an external leak and a pneumatic amplifier diaphragm failure.

51. The method of claim 43, in which a fault template comprising a high I/P drive signal deviation, a nominal outlet pressure error signal, and a null control fluid valve assembly position is attributable to one of a group of component faults consisting of a partially plugged primary orifice, grit in the armature, and a shift in I/P calibration.

52. The method of claim 43, in which a fault template comprising a low I/P drive signal deviation, a low output pressure error signal, and largely positive control fluid valve assembly position is attributable to one of a group of component faults consisting of a blocked I/P nozzle, a pressed I/P armature, a latched I/P, a jammed control fluid valve assembly, and a supply bias diaphragm failure.

53. The method of claim 43, in which a fault template comprising a low I/P drive signal deviation, a nominal outlet pressure error signal, and a null control fluid valve assembly position is attributable to one of a group of component faults consisting of a shift in I/P calibration and a partially plugged I/P nozzle.

54. The method of claim 43, in which the reference outlet pressure signal is generated in response to engagement of the throttling element with a travel stop.

55. The method of claim 54, in which the travel stop comprises a valve seat.

56. The method of claim 54, in which the travel stop comprises an upper travel stop.

57. The method of claim 43, in which the reference outlet pressure signal is near 100%.

58. The method of claim 43, in which the reference outlet pressure signal is near 0%.

59. The method of claim 43, in which the control valve further includes a travel sensor adapted to detect a position of the throttling element, and in which the reference outlet pressure signal is generated in response to a failure of the travel sensor.

60. A positioner system adapted to control a pneumatic actuator coupled to a throttling element, the actuator having at least a first control chamber, the positioner system comprising:

a processor and a memory, the processor receiving an outlet pressure set point and generating an I/P drive signal;

an I/P converter operatively coupled to the processor and responsive to the I/P drive signal to generate a pneumatic control signal;

a pneumatic amplifier operatively coupled to the I/P converter, the pneumatic amplifier having an inlet port in fluid communication with a supply of control fluid, a first outlet port in fluid communication with the actuator first control chamber, and a

control fluid valve assembly adapted to control flow of control fluid from the inlet port to the first outlet port in response to the pneumatic control signal;

a first outlet port pressure sensor adapted to detect a pressure level at the first outlet port and generate a first outlet port pressure signal, wherein the first outlet port pressure sensor is communicatively coupled to the processor, wherein the processor is adapted to compare the first outlet port pressure signal to the outlet pressure set point and generate an outlet pressure error signal, and wherein the processor is adapted to modify the I/P drive signal based on the outlet pressure error signal;

a second sensor communicatively coupled to the processor and adapted to detect a control parameter of the positioner system; and

a diagnostics routine stored in the memory and adapted to be executed on diagnostics information based on at least one diagnostics parameter selected from the group of parameters including the first outlet port pressure level and the control parameter

wherein the processor is further adapted to compare the first outlet port pressure signal and the outlet pressure set point to generate an outlet pressure error signal, and wherein the processor is adapted to modify the I/P drive signal based on the outlet pressure error signal.

61. The system of claim 60, in which the diagnostics routine is further adapted to:

define a normal range for the diagnostics parameter;

trigger a fault signal for operation of the diagnostics parameter outside of the normal range;

characterize selected operating parameters of the positioner system during the fault signal to derive a fault template;

compare the fault template to sets of stored operating parameters associated with specific component failures; and

identify at least one specific potential component failure having a set of stored operating parameters corresponding to the fault template.

62. The system of claim 61, in which the control fluid valve assembly comprises a spool valve, and in which the control parameter comprises a spool valve position signal.

63. The system of claim 61, in which the control fluid valve assembly comprises a pneumatic relay having a beam, and in which the control parameter comprises a beam position signal.

64. The system of claim 61, in which the control parameter comprises an I/P drive signal.

65. The system of claim 61, in which the actuator includes a second control chamber, and in which the pneumatic amplifier further includes a second outlet port in fluid communication with the actuator second control chamber, wherein the control fluid valve assembly is further adapted to control flow of control fluid from the inlet port to the second outlet port, wherein the system further comprises a second outlet port pressure sensor adapted to detect a pressure level at the second outlet port and generate a second outlet port pressure signal, wherein the second outlet port pressure sensor is communicatively coupled to the processor.

66. The system of claim 65, in which the processor is adapted to compare the first outlet port pressure signal and the second outlet port pressure signal to generate an outlet pressure differential signal, to compare the outlet pressure differential signal to the outlet pressure set point to generate an outlet pressure differential error signal, and to modify the I/P drive signal based on the outlet pressure differential error signal.

67. The system of claim 66, further comprising a displacement sensor adapted to detect a control fluid valve assembly position, and in which the diagnostics routine is further adapted to:

characterize an I/P drive signal deviation as high or low;

characterize the output pressure differential error signal as high, null, or low; and

characterize the control fluid valve assembly position as largely positive, null, or largely negative.